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(45) **Date of Patent:** May 10, 2016

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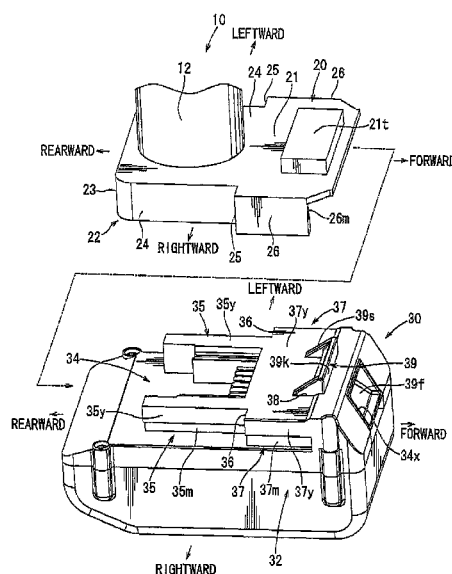
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(57) **ABSTRACT**

A battery pack may have a main connection section and an auxiliary connection section. The main connection section may be connectable with a plurality of electric apparatuses including a specific kind of electric apparatus and a non-specific kind of electric apparatus. The auxiliary connection section may be connectable with only the specific kind of electric apparatus.

**13 Claims, 9 Drawing Sheets**



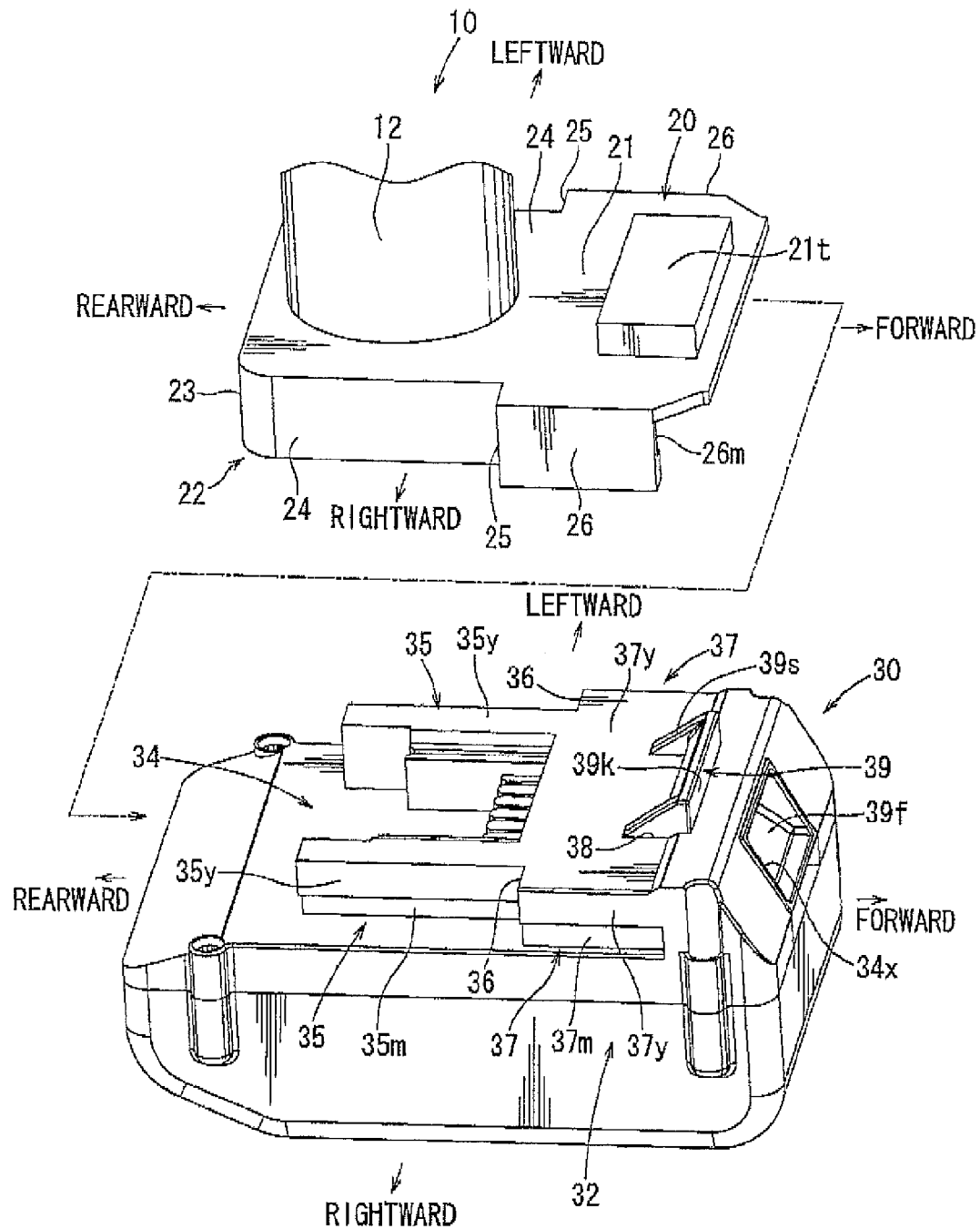


FIG. 1

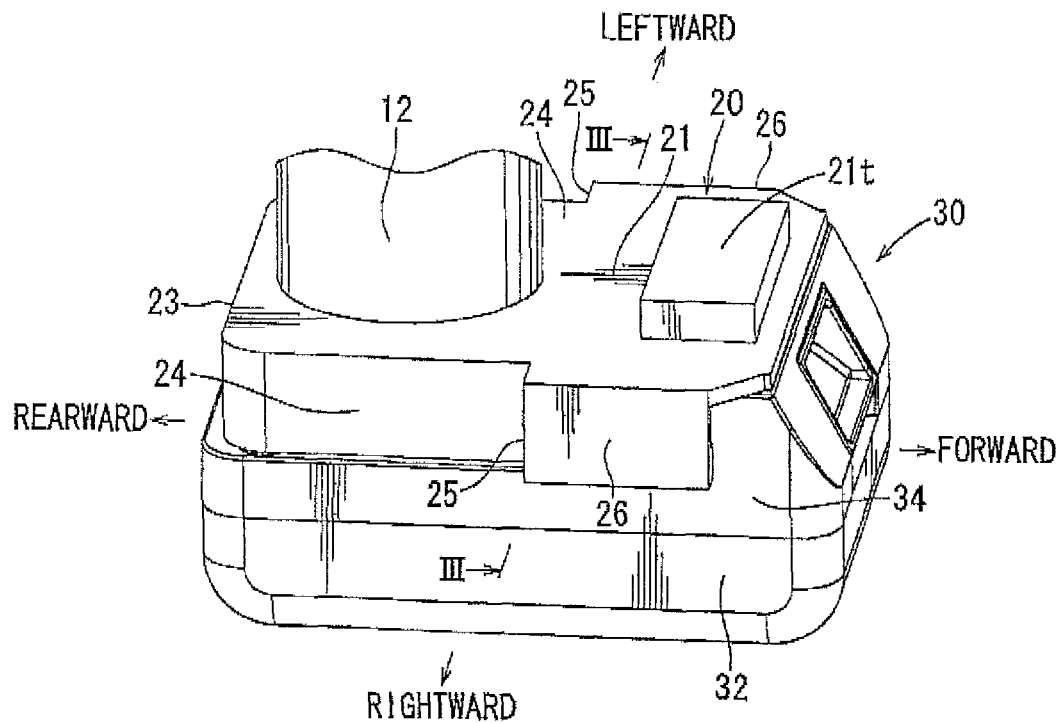


FIG. 2

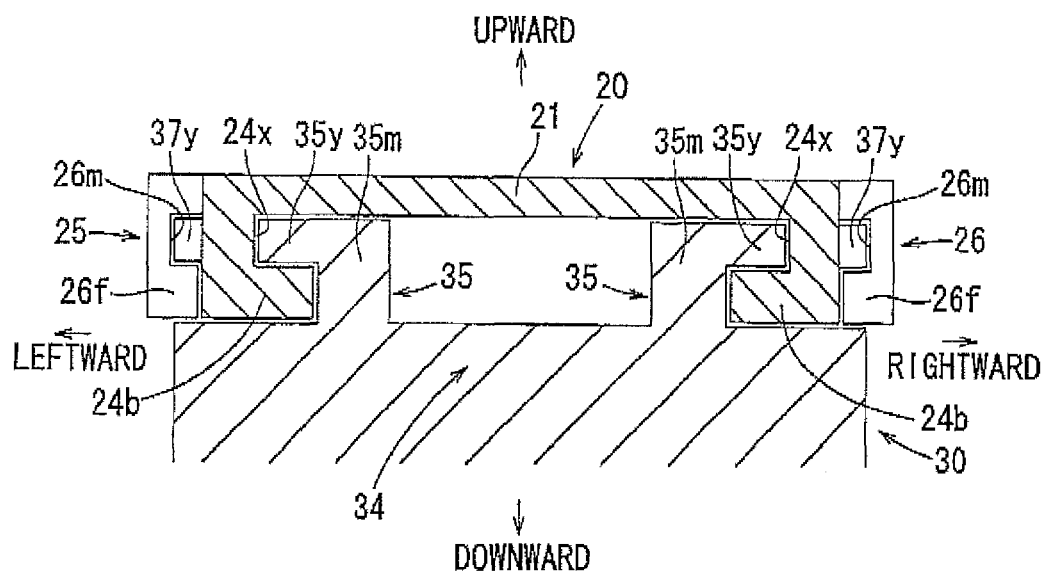


FIG. 3

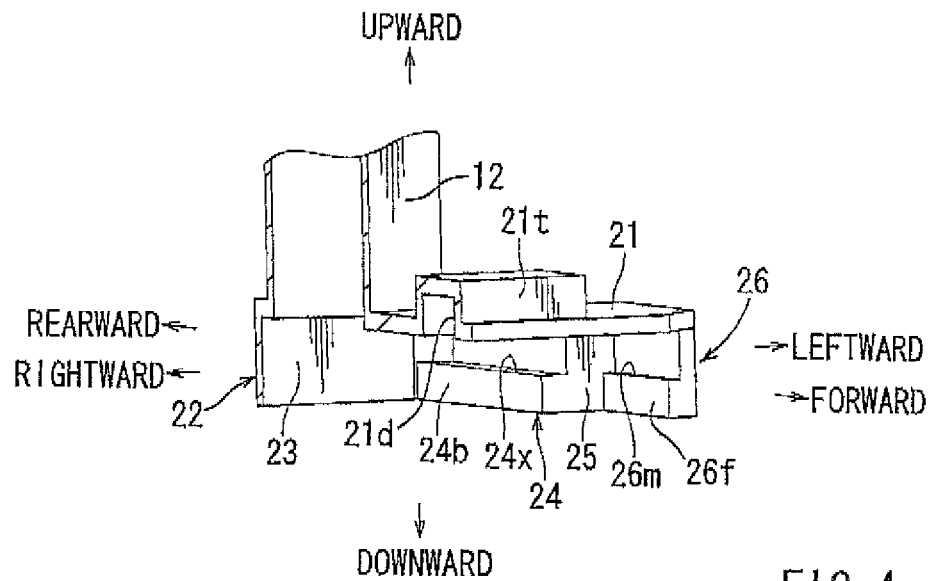


FIG. 4

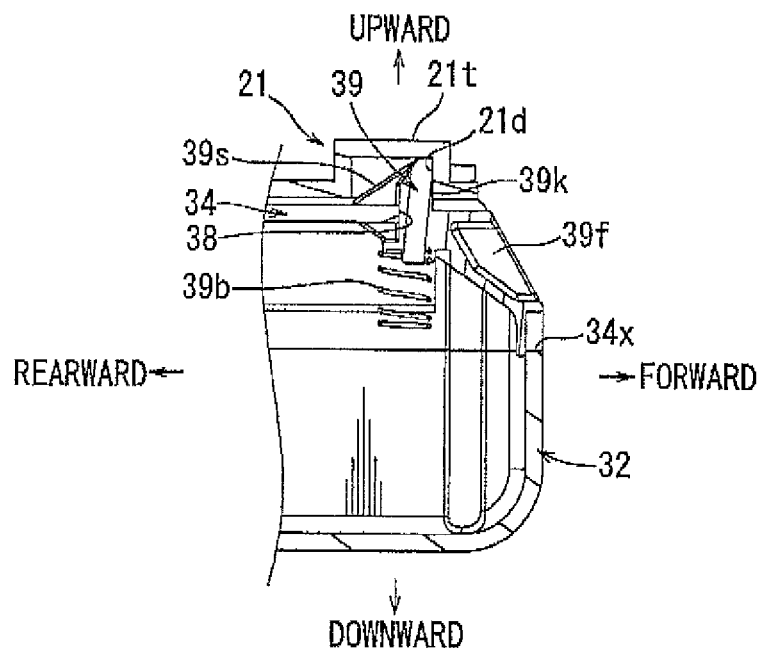
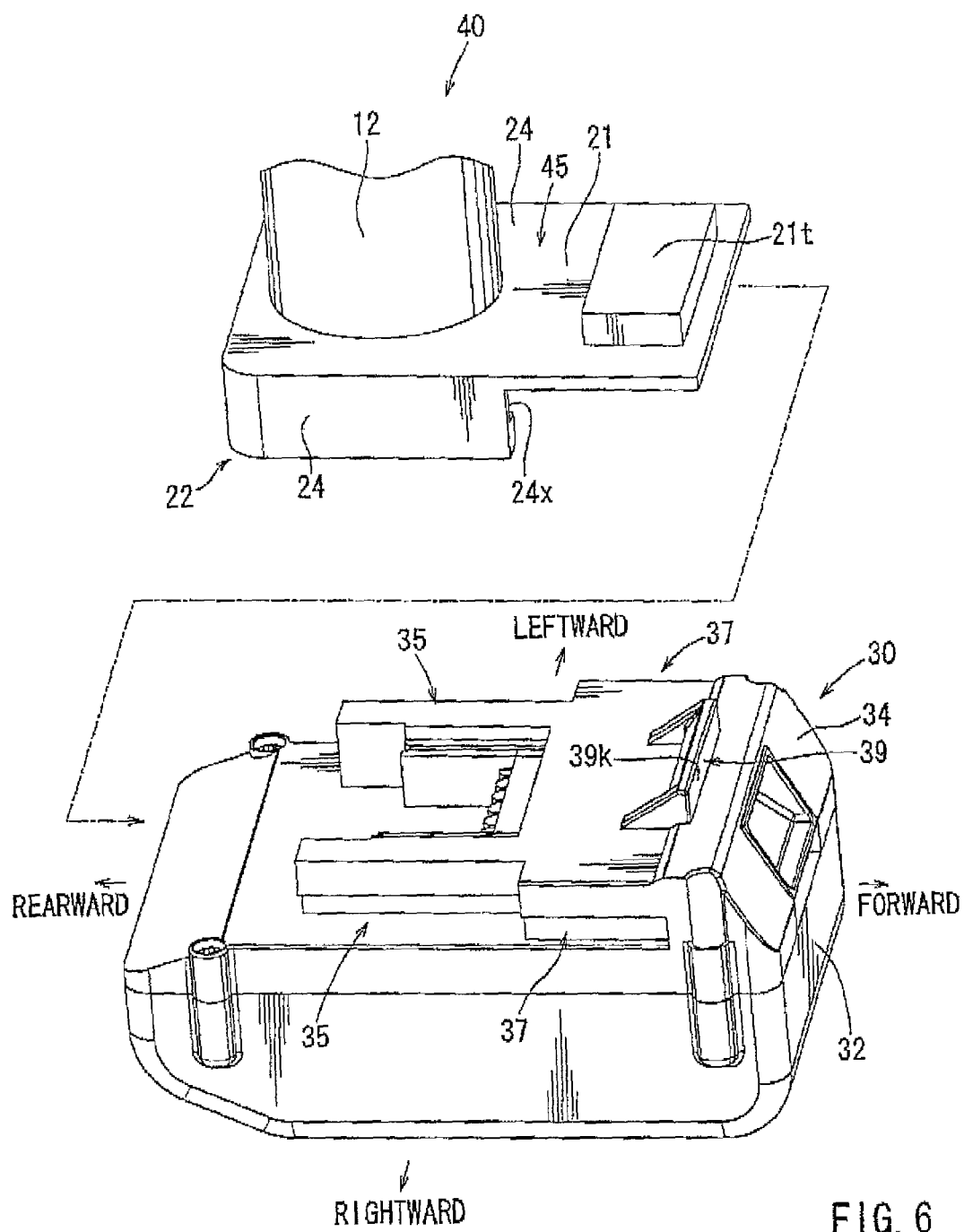
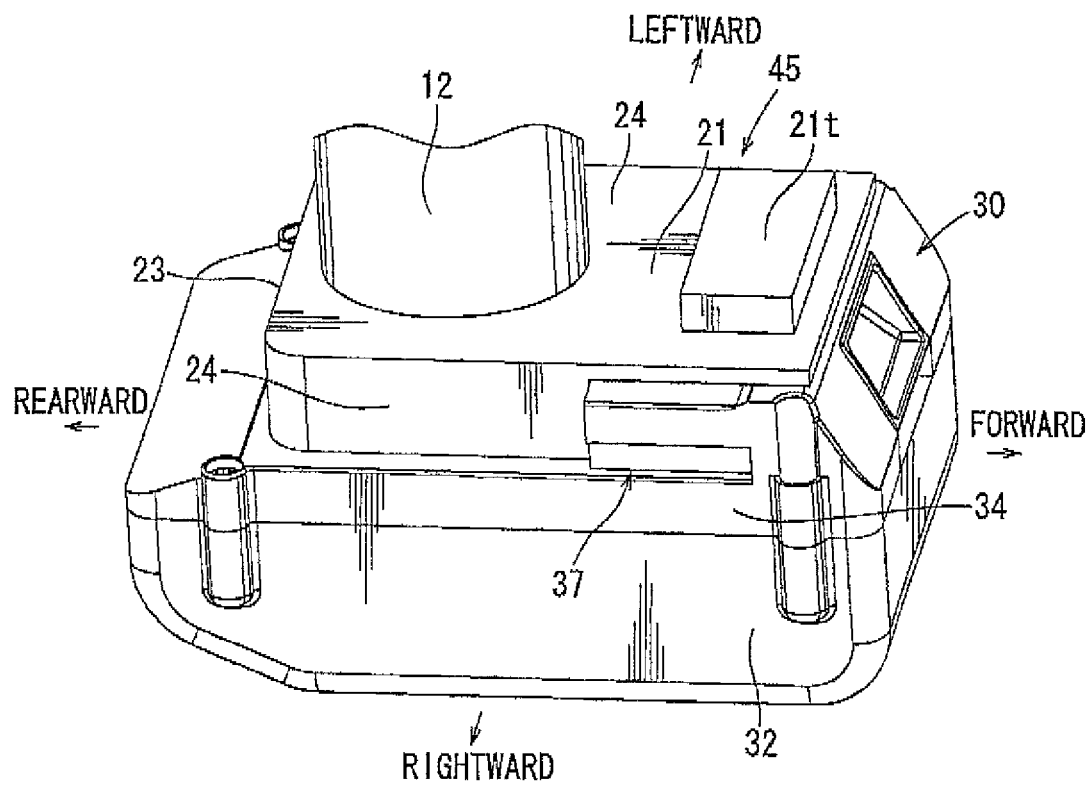
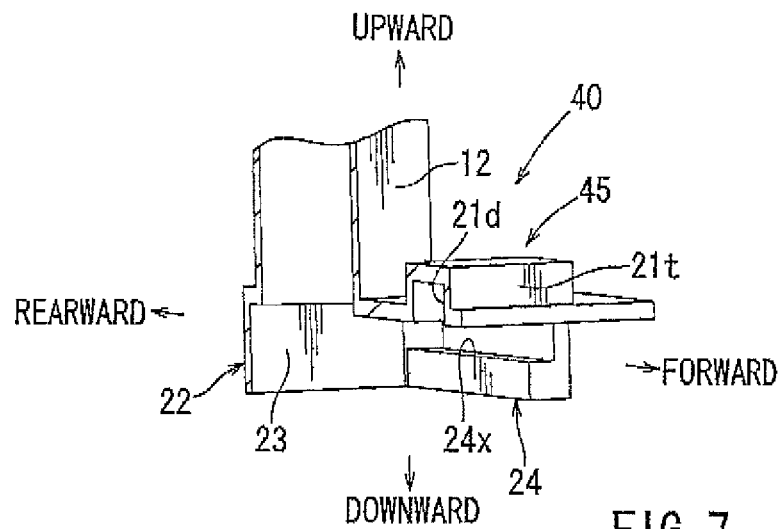


FIG. 5





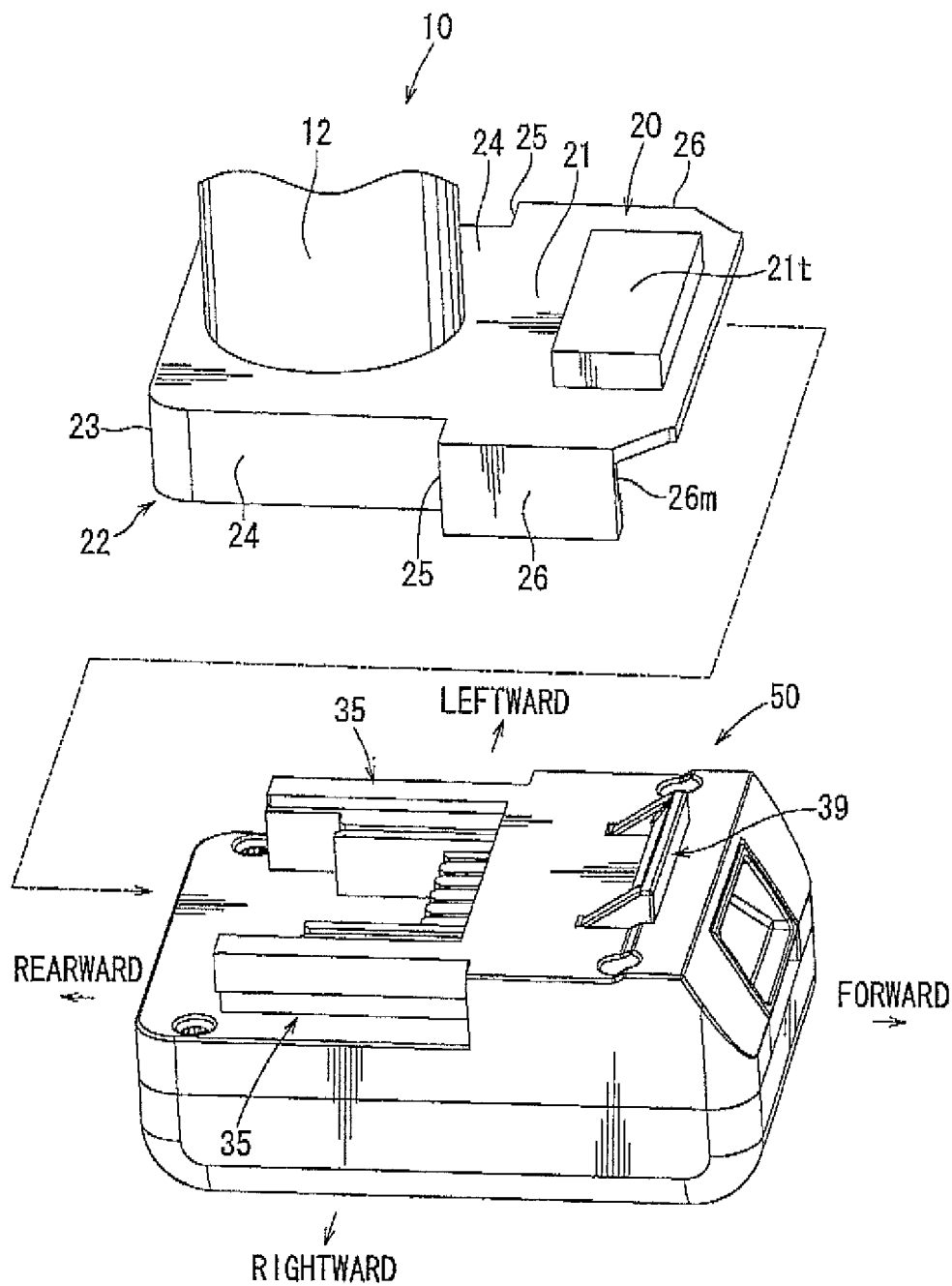


FIG. 9

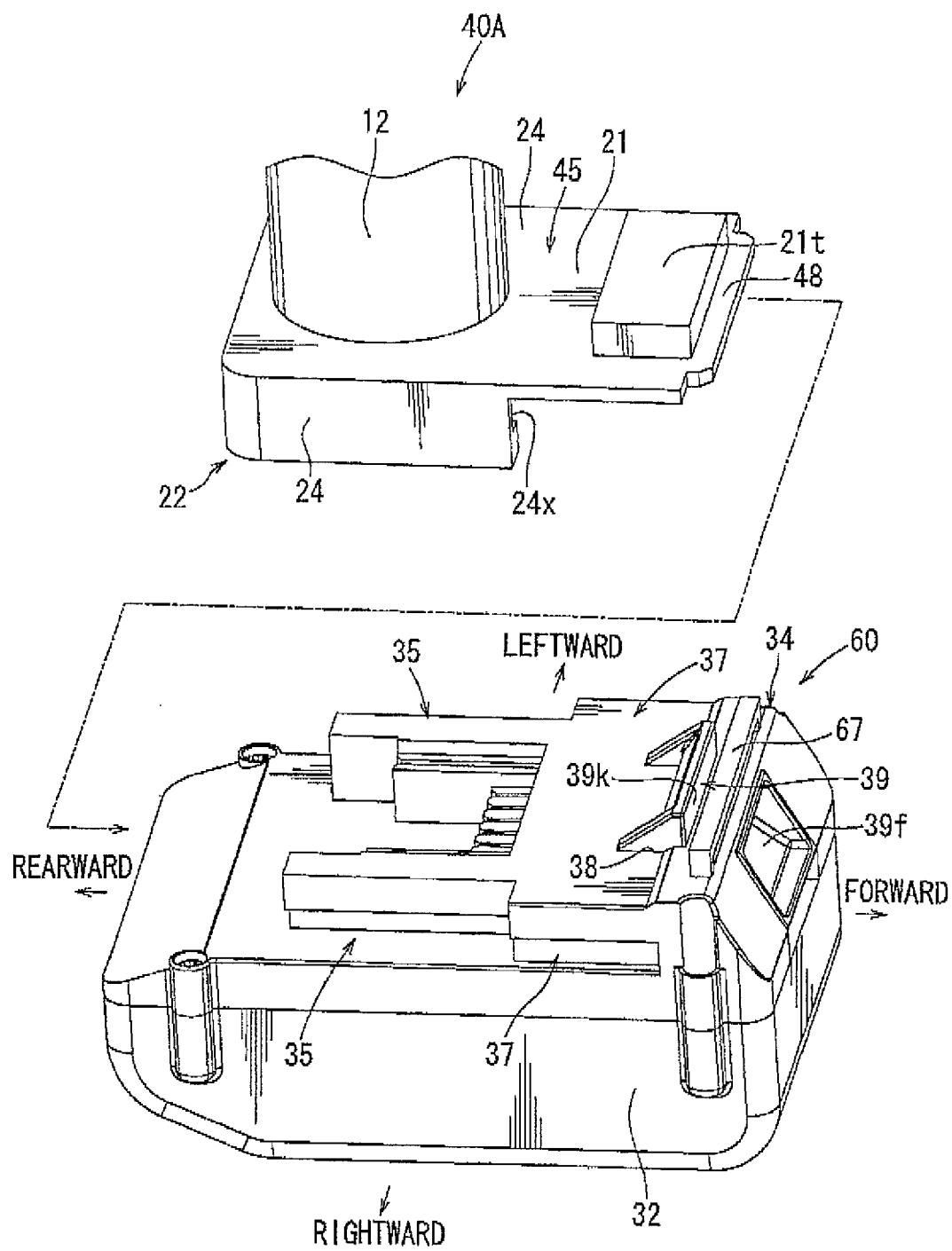


FIG. 10



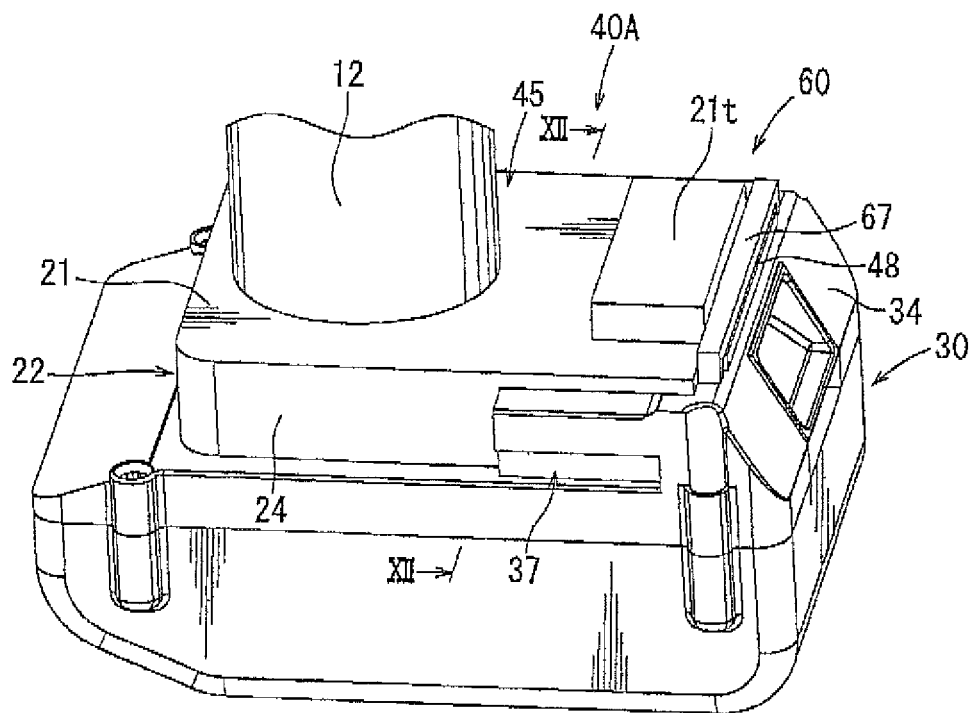


FIG. 11

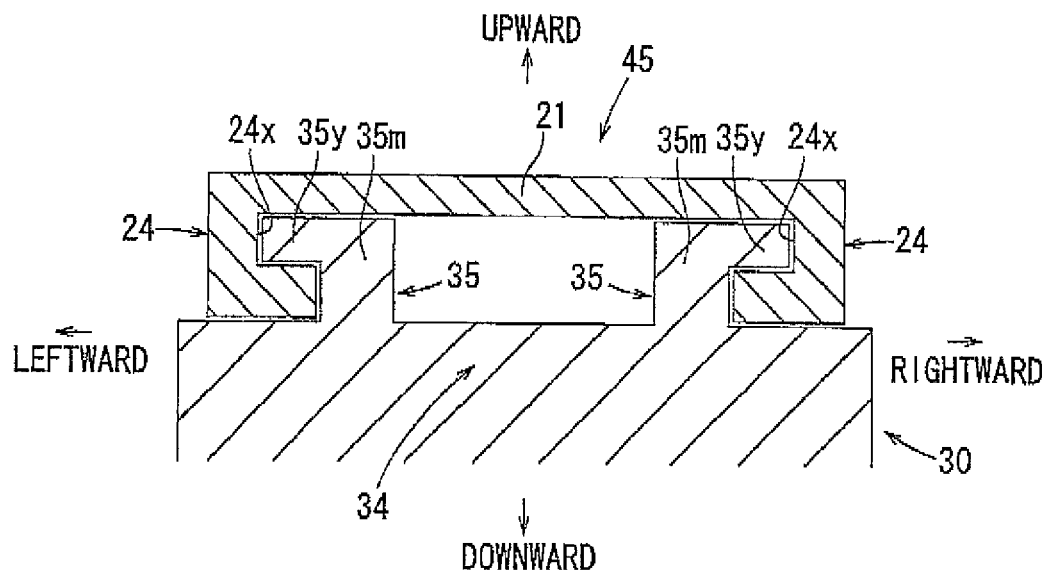


FIG. 12

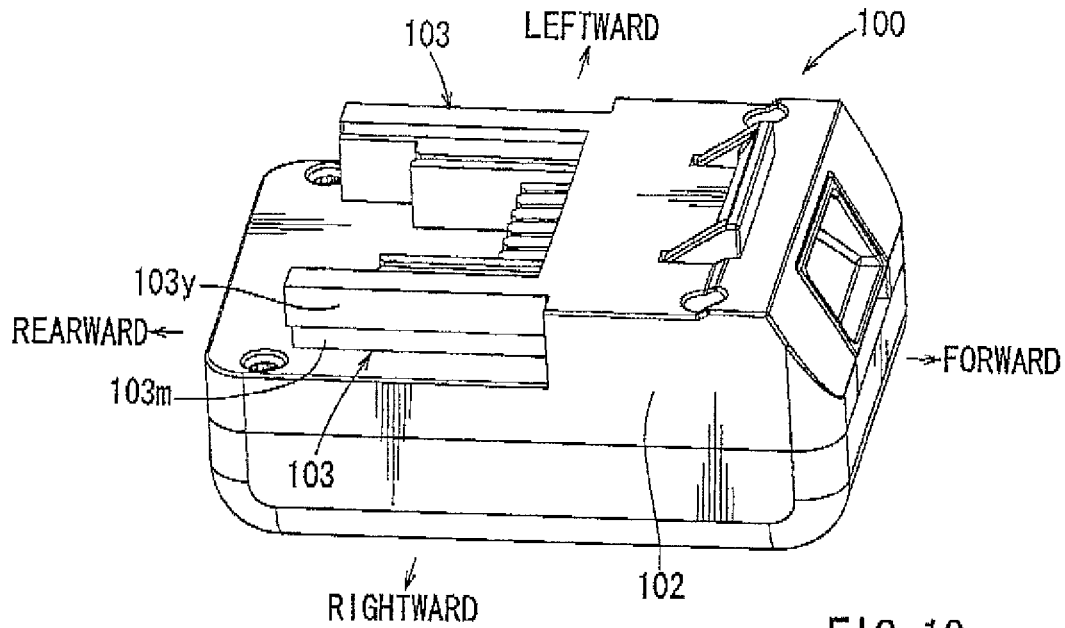


FIG. 13  
PRIOR ART

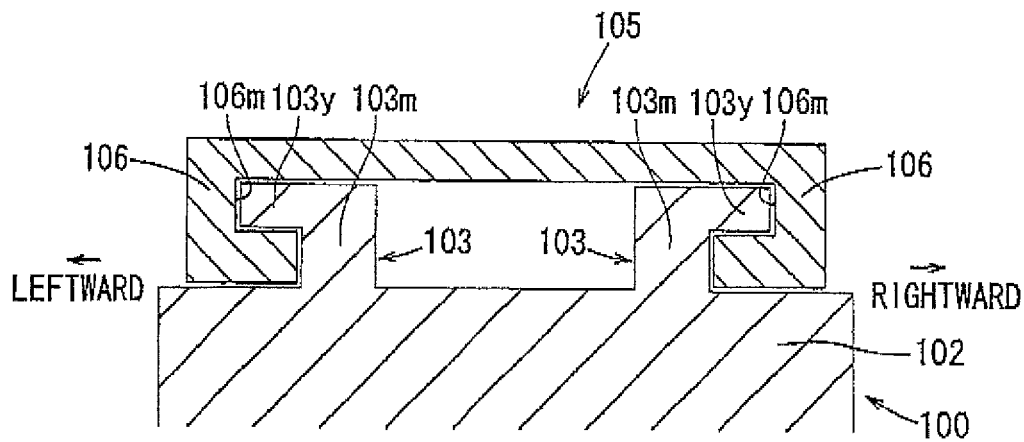


FIG. 14  
PRIOR ART

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# BATTERY PACKS AND SYSTEMS INCLUDING BATTERY PACKS AND ELECTRIC APPARATUS

This application claims priority to Japanese patent application serial number 2012-114189, the contents of which are incorporated herein by reference.

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

Embodiments of the present invention relate to battery packs that may be connected to battery mount portions of electric apparatus. The embodiments also relate to systems including battery packs and electric apparatuses to which the battery packs are connected.

### 2. Description of the Related Art

JP-A-2001-143678 discloses a battery pack **100** shown in FIGS. **13** and **14**. The battery pack **100** is designed for use as a power source of an electric tool. As shown in FIG. **13**, the battery pack **100** includes left and right slide rails **103** disposed at the upper surface of a housing **102** for connection with a battery mount portion **105** (see FIG. **14**) of the electric tool. The slide rails **103** extend in a forward and rearward direction with respect to the battery pack **100**. As shown in FIG. **14**, each of the slide rails **103** includes a rail body **103m** and a laterally projecting linear projection **103y** protruding outward in a widthwise direction (leftward and rightward) by a given distance from the upper end of the rail body **103m**. In this way, each of the slide rails **103** has a substantially inverted L-shape cross-section.

As shown in FIG. **14**, the battery mount portion **105** of the electric tool has a pair of vertical walls **106** at opposite ends in the widthwise direction. A rectangular groove **106m** is formed in the inner wall of each of the vertical walls **106** and extends in the forward and rearward direction for fitting with the corresponding slide rail **103** of the battery pack **100**. Therefore, the battery pack **100** can be connected to the electric tool by initially fitting the laterally projecting linear projections **103y** of the slide rails **103** of the battery pack **100** into the rectangular grooves **106m** of the battery mount portion **105** of the electric tool. Afterwards, it can be accomplished by moving the electric tool and the battery pack **100** to slide relative to each other in the forward and rearward direction.

A plurality of different types of electric tools may have standardized battery mount portions each configured to be similar to the battery mount portion **105**. Also a plurality of different types of battery packs may have standardized slide rails each configured to be similar to the slide rails **103**. In this way, a specific battery pack (e.g., the battery pack **100**) can be shared with a plurality of electric tools.

However, in the case that a plurality of different types of battery packs have standardized slide rails **103**, even a small battery pack is necessary to have the slide rails **103** that are the same as those of a large battery pack.

The standardized slide rails **103** may be too large for a small battery pack, leading to difficulties in reducing the size of the battery packs.

Therefore, there has been a need in the art for enabling a small battery pack having a standardized connection section with a reduced size.

## SUMMARY OF THE INVENTION

In one aspect according to the present teachings, a battery pack may have a main connection section and an auxiliary

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connection section. The main connection section may be connectable with a plurality of different kinds of electric apparatus including a specific kind of electric apparatus and a non-specific kind of electric apparatus. The auxiliary connection section may be connectable with only the specific kind of electric apparatus.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a large battery pack and a battery mount portion of a large electric tool, to which the large battery pack is connected, according to a first embodiment;

FIG. **2** is a perspective view showing the state where the large battery pack and the battery mount portion of the large electric tool have been connected to each other.

FIG. **3** is a sectional view taken along line III-III in FIG. **2**;

FIG. **4** is a perspective view showing a cross-section a central portion of the battery mount portion of the large electric tool;

FIG. **5** is a vertical sectional view showing the operation of a hook of the large battery pack;

FIG. **6** is a perspective view showing the large battery pack and a battery mount portion of a small electric tool, to which the large battery pack is connected;

FIG. **7** is a perspective view showing in cross section a central portion of the battery mount portion of the small electric tool;

FIG. **8** is a perspective view showing the state where the large battery pack and the battery mount portion of the small electric tool have been connected to each other.

FIG. **9** is a perspective view showing a small battery pack and the battery mount portion of the large electric tool, to which the small battery pack is connected;

FIG. **10** is a perspective view showing a large battery pack and a battery mount portion of a small electric tool, to which the large battery pack is connected, according to a second embodiment;

FIG. **11** is a perspective view showing the state where the large battery pack and the battery mount portion of the small electric tool have been connected to each other;

FIG. **12** is a sectional view taken along line XII-XII in FIG. **11**;

FIG. **13** is a perspective view of a known battery pack; and

FIG. **14** is a sectional view showing the state where the known battery pack and a battery mount portion of an electric tool have been connected to each other.

## DETAILED DESCRIPTION OF THE INVENTION

Each of the additional features and teachings disclosed above and below may be utilized separately or in conjunction with other features and teachings to provide improved battery packs and electric apparatus systems. Representative examples of the present invention, which examples utilize many of these additional features and teachings both separately and in conjunction with one another, will now be described in detail with reference to the attached drawings. This detailed description is merely intended to teach a person of skill in the art further details for practicing preferred aspects of the present teachings and is not intended to limit the scope of the invention. Only the claims define the scope of the claimed invention. Therefore, combinations of features and steps disclosed in the following detailed description may not be necessary to practice the invention in the broadest sense, and are instead taught merely to particularly describe representative examples of the invention. Moreover, various fea-

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tures of the representative examples and the dependent claims may be combined in ways that are not specifically enumerated in order to provide additional useful examples of the present teachings. Various examples will now be described with reference to the drawings.

In one embodiment, a battery pack may be connectable with battery mount portions of a plurality of different kinds of electric apparatuses. The battery pack may include a main connection section and an auxiliary connection section. The main connection section may be connectable with main connection complimentary sections of the battery mount portions of the different kinds of electric apparatuses as the main connection section is slid relative thereto. The auxiliary connection section may be connectable with an auxiliary connection complimentary section provided only on the battery mount portion of a specific kind of electric apparatus of the different kinds of electric apparatuses. The main connection section and the auxiliary connection section are configured such that the weight of the battery pack may be supported at the main connection section and the auxiliary connection section when the battery pack is connected to the battery mount portion of the specific kind of electric apparatus.

With this arrangement, in the case where the main connection section used for connection with the battery mount portions of the different kinds of electric apparatuses is designed to have a small size, the weight of the battery pack can be securely supported with the aid of the auxiliary connection section even using a large battery pack having a weight that is relatively large.

By designing the main connection section to be small in size in this way, it is possible to reduce the size of the battery pack. Incorporating the main connection section as a standardized connection section for different battery packs for connection with different kinds of electric apparatuses can be useful. One such embodiment may include a battery pack having only the main connection section. In such an embodiment, a battery pack having only the main connection section can be configured to have a small size.

The main connection section and the auxiliary connection section may be disposed at positions spaced apart from each other. With this arrangement, the weight of the battery pack can be efficiently supported at two different positions.

The auxiliary connection section may be connectable with the auxiliary connection complimentary section as the auxiliary connection section is slid relative to the auxiliary connection complimentary section.

The main connection section may be connectable with the main connection complimentary section of the battery mount portion of the specific kind of electric apparatus as the main connection section is slid relative to the main connection complimentary section in a first sliding direction. On the other hand, the auxiliary connection section may be connectable with the auxiliary connection complimentary section of the battery mount portion of the specific kind of electric apparatus as the auxiliary connection section is slid relative to the auxiliary connection complimentary section in a second sliding direction that is the same as the first direction.

The auxiliary connection complimentary section may include a projection. The auxiliary connection section may include an engaging portion engageable with the projection.

The engaging portion may be disposed at a position determined such that the engaging portion engages the projection after the main connection section is slid in a direction relative to the main connection complimentary section of the battery mount portion of the specific kind of electric apparatus.

The main connection section and the auxiliary connection section may be respectively connectable with the main con-

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nection complimentary section and the auxiliary connection complimentary section of the battery mount portion of the specific kind of electric apparatus. However, only the main connection section may be connectable with the main connection complimentary section of the battery mount portion of the other kinds of electric apparatuses other than the specific kind of electric apparatus.

In another embodiment, a system may include different kinds of electric apparatuses each having a battery mount portion, and different kinds of battery packs connectable with the battery mount portions. The different kinds of electric apparatuses may include a specific kind of electric apparatus and a non-specific kind of electric apparatus. The different kinds of battery packs may include a specific kind of battery pack having a main connection section and an auxiliary connection section, and non-specific kind of battery pack having a main connection section and no auxiliary connection section. The battery mount portion of the specific kind of electric apparatus may include a main connection complimentary section and an auxiliary connection complimentary section. The main connection complimentary section of the battery mount portion of the specific kind of electric apparatus may be connectable with the different kinds of battery packs as the different kinds of battery packs are slid in a sliding direction relative to the main connection complimentary section. The auxiliary connection complimentary section of the battery mount portion of the specific kind of electric apparatus may be connectable with the auxiliary connection section of the specific kind of battery pack. The battery mount portion of the non-specific kind of electric apparatus may include a main connection complimentary section and no auxiliary connection complimentary section. The main connection complimentary section of the battery mount portion of the non-specific kind of electric apparatus may be connectable with the different kinds of battery packs as the different kinds of battery packs are slid in a sliding direction relative to the main connection complimentary section. The main connection section and the auxiliary connection section of the specific kind of battery pack may be configured such that the weight of the specific kind of battery pack can be supported at the main connection section and the auxiliary connection section when the specific kind of battery pack is connected to the battery mount portion of the specific kind of electric apparatus.

In a further embodiment, a system may include a specific kind of electric apparatus having a battery mount portion, and different kinds of battery packs connectable with the battery mount portion. The different kinds of battery packs may include a specific kind of battery pack having a main connection section and an auxiliary connection section, and non-specific kind of battery pack having a main connection section and no auxiliary connection section. The battery mount portion of the specific kind of electric apparatus may include a main connection complimentary section and an auxiliary connection complimentary section. The main connection complimentary section of the battery mount portion of the specific kind of electric apparatus may be connectable with different kinds of battery packs as the different kinds of battery packs are slid in a sliding direction relative to the main connection complimentary section. The auxiliary connection complimentary section of the battery mount portion of the specific kind of electric apparatus may be connectable with the auxiliary connection section of the specific kind of battery pack. The main connection section and the auxiliary connection section of the specific kind of battery pack may be configured such that the weight of the specific kind of battery pack can be supported at the main connection section and the auxiliary connection section when the specific kind of battery

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pack is connected to the battery mount portion of the specific kind of electric apparatus. The main connection section of the non-specific kind of battery pack may be configured such that the weight of the non-specific kind of battery pack can be supported only at the main connection section when the non-specific kind of battery pack is connected to the battery mount portion of the specific kind of electric apparatus.

An embodiment will now be described with reference to FIGS. 1 to 9. A battery pack 30 can be used as a power source for driving an electric tool 10 (only a part is shown in the drawings). To this end, the battery pack 30 can be removably connected to a battery mount portion 20 of the electric tool 10. In the following description, forward, rearward, leftward, rightward, upward and downward directions are determined to correspond to those for the battery pack 30 and the electric tool 10.

<Battery Mount Portion of Power Tool>

The battery mount portion 20 of the electric tool 10 will be first described before describing the battery pack 30. The electric tool 10 may be a large electric tool having a grip portion 12 that can be grasped by a user. The grip portion 12 may have a lower end portion where the battery mount portion 20 is disposed for connection with the battery pack 30. In the following description, the electric tool 10 will be also referred to as a large electric tool 10.

As shown in FIG. 1, the battery mount portion 20 may have a shape like a rectangular lid extending both in a widthwise direction (left and right direction) and a forward direction from the lower end portion of the grip portion 12. The battery mount portion 20 may have a rectangular top plate 21 and a fence-like vertical wall 22. The vertical wall 22 may extend downward from the left and right edges and the rear edge of the top plate 21. More specifically, the vertical wall 22 may have a substantially U-shape with its front side opened as seen in a plan view. The vertical wall 22 may include a rear end wall portion 23, left and right rear-side lateral wall portions 24 and left and right front-side lateral wall portions 26. Stepped portions 25 may be formed at boundary positions between the rear-side lateral wall portions 24 and the front-side lateral wall portions 26, so that the distance between the front-side lateral wall portions 26 may be larger than the distance between the rear-side lateral wall portions 24 by a distance given by the stepped portions 25.

In this way, the left and right front-side lateral wall portions 26 are positioned on the outer side with respect to the widthwise direction of the left and right rear-side lateral wall portions 24. The length in the forward and rearward direction of the rear-side lateral wall portions 24 may be longer than the length in the forward and rearward direction of the front-side lateral wall portions 26.

The front-side lateral wall portions 26 as well as the rear-side lateral wall portions 24 may be symmetrical with respect to their right and left sides. As shown in FIG. 4, a front-side linear projection 26f may be formed on the lower end portion of the inner surface of each of the front-side lateral wall portions 26 to protrude inward therefrom by a given distance. A front-side rectangular groove 26m may be cleaned between the front-side linear projection 26f and the top plate 21. Similarly, a rear-side linear projection 24b may be formed on the lower end portion of the inner surface of each of the rear-side lateral wall portion 24 to protrude inward therefrom by a given distance. A rear-side rectangular groove 24x may be defined between the rear-side linear projection 24b and the top plate 21. The stepped portion 25 may separate the rear-side rectangular groove 24x and the front-side rectangular groove 26m positioned on the same side (right side or left side), from each other (see FIG. 4).

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As shown in FIGS. 4 and 5, a rectangular projection 21f having a hat-like cross-sectional configuration may be formed at the front portion of the top plate 21. A hook-receiving stepped portion 21d may be defined at the front portion of the inner surface of the rectangular projection 21f. <Battery Pack>

The battery pack 30 may have a large storage capacity for supplying an electric power to the large electric tool 10. In the following description, the battery pack 30 will be also referred to as a large battery pack 30.

As shown in FIG. 1, the large battery pack 30 may include a housing body 32 and a lid 34. The housing body 32 may have an upper opening and may be configured to receive a plurality of battery cells (not shown). The lid 34 may be configured to close the upper opening of the housing body 32.

A pair of rear-side slide rails 35 may be formed on the left side and the right side of the central portion (with respect to the forward and rearward directions) of the lid 34 and may extend in the forward and rearward directions. A pair of front-side slide rails 35 may be formed on the left side and the right side of the front portion of the lid 34 and may extend in the forward and rearward directions. Stepped portions 36 may be formed at the boundary positions between the front-side slide rails 37 and the rear-side slide rails 35.

The distance between the left and right front-side slide rails 37 may be set to conform to the distance between the left and right front-side lateral wall portions 26 of the battery mount portion 20 of the large electric tool 10. Similarly, the distance between the left and right rear-side slide rails 35 may be set to conform to the distance between the left and right rear-side lateral wall portions 24 of the battery mount portion 20.

In this way, the left and right front-side slide rails 37 may be positioned outward with respect to the widthwise direction of the left and right rear-side slide rails 35. In addition, the length in the forward and rearward directions of the rear-side slide rails 35 may be longer than the length in the forward and rearward directions of the front-side slide rails 37.

As shown in FIGS. 1 and 3, each of the rear-side slide rails 35 may include a rail body 35m and a lateral linear projection 35y protruding outward in the widthwise direction (left and right direction) by a given distance from the upper end portion of the rail body 35m. In this way, each of the rear-side slide rails 35 may have a substantially inverted L-shaped cross section. The lateral linear projections 35y of the rear-side slide rails 35 may be fitted into the rear-side rectangular grooves 24x of the battery mount portion 20 of the large electric tool 10 so as to be slid relative thereto in the forward and rearward directions.

Similarly, as shown in FIG. 1, each of the front-side slide rails 37 may include a rail body 37m and a lateral linear projection 37y protruding outward in the widthwise direction (left and right direction) by a given distance from the upper end portion of the rail body 37m. The lateral linear projections 37y of the front-side slide rails 37 may be fitted into the front-side rectangular grooves 26m of the battery mount portion 20 of the large electric tool 10 so as to be slid relative thereto in the forward and rearward directions.

A slit-like opening 38 having a laterally facing U-shape in plan view may be formed in the lid 34 of the large battery pack 30 at a position between the left and right front-side slide rails 37. A hook 39 may protrude outward from the lid 34 through the slit-like opening 38 for preventing the large electric tool 10 from being slid rearward beyond the hook 39 (i.e., from being removed from the lid 34 as a result of the rearward sliding movement). As shown in FIG. 1, the hook 39 may include a slide lock portion 39k and a lock release button 39f formed integrally with each other. The slide lock portion 39k

can protrude upward through the slit-like opening **38** of the lid **34**. The lock release button **39f** may be exposed to the outside at an operation opening **34x** formed in the front portion of the lid **34**. The slide lock portion **39k** may include a front portion having a front surface extending substantially vertically, and a rear portion that may have an inclined surface **39s** for contacting a front end portion of the top plate **21** of the battery mount portion **20**. A spring **39b** may be disposed inside of the lid **34** in order to bias the hook **39** to move upward (see FIG. 5). The hook **39** may be normally held at an uppermost position by the biasing force of the spring **39b**. The front surface of the front portion of the slide lock portion **39k** may engage the hook receiving stepped portion **21d** formed inside of the rectangular projection **21t** of the battery mount portion **20**, so that the sliding movement in the removing direction (rearward sliding movement) of the large electric tool **10** can be prevented.

As the lock release button **39** is pressed to move the hook **39** downward against the biasing force of the spring **39b**, the slide lock portion **39k** may be disengaged from the hook receiving stepped portion **21d** of the battery mount portion **20** to enable the large electric tool **10** to slide in the removing direction (rearward direction).

<Connection between Large Battery Pack and Large Electric Tool>

In order to connect the large battery pack **30** and the large electric tool **10**, the large electric tool **10** may be moved horizontally forward from the rear side of the large battery pack **30**, so that the front ends of the left and right rear-side rectangular grooves **24x** of the battery mount portion **20** of the large electric tool **10** are brought to be fitted with the rear ends of the left and right rear-side slide rails **35** of the large battery pack **30**. Then, the battery mount portion **20** of the large electric tool **10** may be pushed forward relative to the large battery pack **30**, so that the left and right rear-side slide rails **35** and the left and right rear-side rectangular grooves **24x** may slide relative to each other in the forward and rearward directions while they are fitted with each other. In the course of the forward sliding movement of the battery mount portion **20** of the large electric tool **10** relative to the large battery pack **30**, the front ends of the left and right front-side rectangular grooves **26m** of the battery mount portion **20** may be fitted with the rear ends of the left and right front-side slide rails **37** of the large battery pack **30**. As the battery mount portion **20** of the large electric tool **10** is pushed further forward relative to the large battery pack **30**, the left and right front-side slide rails **37** and the left and right front-side rectangular grooves **26m** as well as the left and right rear-side slide rails **35** and the left and right rear-side rectangular grooves **24x** may slide relative to each other in the forward and rearward direction while they are fitted with each other.

In the course of the forward sliding movement of the battery mount portion **20** of the large electric tool **10** relative to the large battery pack **30**, the top plate **21** of the battery mount portion **20** may contact the inclined surface **39s** of the hook **39** of the large battery pack **30** and may then be slid relative thereto, so that the hook **39** may be pressed downward against the biasing force of the spring **39b**. When the battery mount portion **20** of the large electric tool **10** has been slid forward relative to the large battery pack **30** to reach a connection completion position, the rectangular projection **21t** of the top plate **21** of the battery mount portion **20** may be positioned to be opposed to the hook **39**, so that the hook **39** may protrude upward through the slit-like opening **38** by the biasing force of the spring **39b**. Then, the slide lock portion **39k** (more specifically, its front surface) may engage the hook receiving stepped portion **21d** of the battery mount portion **20**, so that

the large electric tool **10** may be prevented from being slid further in the removing direction (rearward sliding movement).

In addition, when the battery mount portion **20** of the large electric tool **10** has been slid forward relative to the large battery pack **30** to reach the connection completion position, power source terminals and signal terminals (not shown) of the large electric tool **10** may be respectively electrically connected to power source terminals and signal terminals (not shown) of the large battery pack **30**.

In this way, the battery mount portion **20** of the large electric tool **10** and the large battery pack **30** may be connected to each other by way of fitting between the left and right rear-side slide rails **35** and the left and right rear-side rectangular grooves **24x** and also by way of fitting between the left and right front-side slide rails **37** and the left and right front-side rectangular grooves **26m**. As a result, the weight of the large battery pack **30** that may be relatively large due to its large capacity may be supported in stable at two positions or at the rear-side slide rails **35** and the front-side slide rails **37**. <Connection between Large Battery Pack and Small Electric Tool>

The large battery pack **30** may be connectable with a small electric tool **40** as shown in FIG. 6.

A battery mount portion **45** of the small electric tool **40** may be different from the battery mount portion **20** of the large electric tool **10** in that the width of the battery mount portion **45** is smaller than that of the battery mount portion **20**. In addition, the battery mount portion **45** may be different from the battery mount portion **20** in that the battery mount portion **45** does not have the left and right front-side lateral wall portions **26** nor the stepped portions **25**. In other respect, the battery mount portion **45** may be configured to be the same as the battery mount portion **20**. Therefore, in FIGS. 6 and 7, like members are given the same reference numerals as the battery mount portion **20** and the description of these members will not be repeated.

Thus, as shown in FIGS. 6 and 7, the battery mount portion **45** may have a vertical wall **22** having a substantially U-shape with its front side opened as seen in a plan view. The vertical wall **22** may include a rear end wall portion **23** and left and right rear-side lateral wall portions **24**. The distance between the left and right rear-side lateral wall portions **24** of the battery mount portion **45** may be set to be equal to the distance between the left and right rear-side lateral wall portions **24** of the battery mount portion **20**.

In order to connect the large battery pack **30** and the small electric tool **40**, the small electric tool **40** may be moved horizontally forward from the rear side of the large battery pack **30**, so that the front ends of the left and right rear-side rectangular grooves **24x** of the battery mount portion **45** of the small electric tool **40** are brought to be fitted with the left and right rear-side slide rails **35** of the large battery pack **30**. Then, the left and right rear-side slide rails **35** and the left and right rear-side rectangular grooves **24x** may slide relative to each other in the forward and rearward directions while they are fitted with each other. In the course of the forward sliding movement of the battery mount portion **45**, the hook **39** may be pressed downward against the biasing force of the spring **39b** as described previously. When the battery mount portion **45** has reached a connection completion position, the hook **39** may protrude upward through the slit-like opening **38** by the biasing force of the spring **39b**. Then, the slide lock portion **39k** may engage the hook receiving stepped portion **21d** of the battery mount portion **45**, so that the battery mount portion **45** of the small electric tool **40** may be connected to the large battery pack **30** as shown in FIG. 8.

## &lt;Small Battery Pack&gt;

A small battery pack **50** shown in FIG. **9** may be typically used as a power source for the small power tool **40**. In FIG. **9**, like members are given the same reference numerals as the large battery pack **30** and the description of these members will not be repeated. The small battery pack **50** is different from the large battery pack **30** in that the housing size is smaller than that of the large battery pack **30** and that it only has left and right slide rails **35** that may be the same in the specification (standard) as the left and right rear-side slide rails **35** of the large battery pack **30**. In other respect, the small battery pack **50** may be configured to be the same as the large battery pack **30**.

## &lt;Connection of Small Battery Pack to Small Electric Tool and to Large Electric Tool&gt;

In order to connect the small electric tool **40** to the small battery pack **50**, the left and right rear-side rectangular grooves **24x** of the battery mount portion **45** of the small electric tool **40** are brought to be fitted with the left and right slide rails **35** of the small battery pack **50**. Then, the left and right slide rails **35** and the left and right rear-side rectangular grooves **24x** may be slid relative to each other in the forward and rearward directions. When the battery mount portion **45** has reached a connection completion position, the slide lock portion **39k** of the hook **39** may engage the hook receiving stepped portion **21d** by the biasing force of the spring **39b**, so that the small electric tool **40** may be connected to the small battery pack **50**.

Here, the distance between the left and right rear-side lateral wall portions **24** of the battery mount portion **45** of the small electric tool **10** may be determined to be equal to the distance between the left and right rear-side lateral wall portions **24** of the battery mount portion **20** of the large electric tool **10**. Therefore, the small battery pack **50** can be connected to the battery mount portion **20** of the large electric tool **10** by fitting the left and right slide rails **35** of the small battery pack **50** into the left and right rear-side rectangular grooves **24x** of the small battery pack **50** and thereafter moving the slide rails **35** to slide relative to the rectangular grooves **24x**.

As described above, both of the left and right slide rails **35** of the small battery pack **50** and the left and right rear-side slide rails **35** of the large battery pack **30** can be connected to both of the battery mount portion **20** of the large electric tool **10** and the battery mount portion **45** of the small electric tool **40**.

In this way, the left and right slide rails **35** of the small battery pack **50** and the left and right rear-side slide rails **35** of the large battery pack **30** respectively serve as main connection sections, while the left and right front-side slide rails **37** of the large battery pack **30** serves as an auxiliary connection section. The left and right rear-side slide rectangular grooves **24x** of each of the large electric tool **10** and the small electric tool **40** may serve as a main connection complimentary section, while the left and right front-side rectangular grooves **26m** of the large electric tool **10** may serve as an auxiliary connection complimentary section.

## &lt;Advantages of Large Battery Pack&gt;

The large battery pack **30** according to the above embodiment includes the left and right rear-side slide rails **35** (main connection section) and the left and right front-side slide rails **37** (auxiliary connection section). In addition, the left and right rear-side slide rails **35** (main connection section) and the left and right front-side slide rails **37** (auxiliary connection section) can be respectively connected to the left and right rear-side rectangular grooves **24x** (main connection complimentary section) and the left and right front-side rectangular grooves **26m** (auxiliary connection complimentary section)

of the battery mount portion **20** of the large power tool **10** (i.e., a specific kind of electric apparatus). Further, the weight of the large battery pack **30** can be supported at the left and right rear-side slide rails **35** (main connection section) and the left and right front-side slide rails **37** (auxiliary connection section).

Therefore, even in the case that the left and right rear-side slide rails **35** (main connection section) used for connection with the large electric tool **10** and the small electric tool **40** (more specifically, their battery mount portions) are configured to be small in size, it may be still possible to support a large weight due to the presence of the left and right front-side slide rails **37** (auxiliary connection section).

In this way, by minimizing the size of the left and right rear-side slide rails **35** (main connection section) used for connection with the large electric tool **10** and the small electric tool **40** (more specifically, their battery mount portions), it is possible to minimize the size of the small battery pack **50** that has only the left and right slide rails **35** (main connection section).

Further, in the large battery pack **30**, the left and right rear-side slide rails **35** (main connection section) are spaced apart from the left and right front-side slide rails **37** (auxiliary connection section). With this arrangement, the weight of the large battery pack **30** can be efficiently supported at the left and right rear-side slide rails **35** (main connection section) and the left and right front-side slide rails **37** (auxiliary connection section).

An embodiment will now be described with reference to FIGS. **10** to **12**. A gate-shaped engaging portion **67** is provided on the front side of the hook **39** (more specifically, the slit-shaped opening **38**) of the battery pack **60** in this embodiment. In other respects, the battery pack **60** may be the same as the large battery pack **30** previously described. Therefore, in the battery pack **60** shown in FIGS. **10** to **12**, like members are given the same reference numerals as the battery pack **30**, and the description of these members will not be repeated.

Further, according to this embodiment, a small power tool **40A**, to which the battery pack **60** is connected, has a projection **48** formed at the front end of the top plate **21**. The projection **48** may be fitted into the gate-shaped engaging portion **67** of the battery pack **60** in the sliding direction. In other respects, the construction of the small power tool **40A** may be the same as the small power tool **40** previously described. Therefore, in the small power tool **40A** shown in FIGS. **10** to **12**, like members are given the same reference numerals as the small power tool **40**, and the description of these members will not be repeated.

Therefore, the left and right rear-side rectangular grooves **24x** of the battery mount portion **45** of the small electric tool **40A** may be brought to be fitted with the left and right rear-side slide rails **35** of the battery pack **60** and may be slid relative to the left and right rear-side slide rails **35** as shown in FIG. **12**. When the battery mount portion **45** has reached a connection completion position, the projection **48** of the small electric tool **40A** may be fitted into the gate-shaped engaging portion **67** of the battery pack **60**.

In this way, the weight of the battery pack **60** can be supported at the left and right rear-side slide rails **35** and also at the gate-shaped engaging portion **67**. In other words, the weight of the battery pack **60** can be supported at the gate-shaped engaging portion **67** in place of the left and right front-side slide rails **37**.

Thus, the gate-shaped engaging portion **67** may serve as an auxiliary connection section, while the projection **48** of the battery mount portion **45** of the small electric tool **40A** may serve as an auxiliary connection complimentary section.

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## &lt;Possible Modifications&gt;

The above first and second embodiments may be modified in various ways. For example, although the large electric tool 10 and the small electric tools 40 and 40A have been exemplified in the above embodiments, the present teachings can also be applied to any other electric apparatus, such as a grass cutter and a clipper.

Further, although the gate-shaped engaging portion 67 has been exemplified as an example of the auxiliary connection section of the battery pack 60, the gate-shaped engaging portion 67 may be replaced with one or some of the terminals of the battery pack 60 formed to have a hook shape for hooking to a part of the top plate 21 of the small electric tool 40A.

What is claimed is:

1. A battery pack configured to be connectable with battery mount portions of a plurality of electric apparatuses, the battery pack comprising:

a main connection section configured to be connectable with main connection complimentary sections of the battery mount portions of the plurality of electric apparatuses as the main connection section is slid relative thereto in a direction; and

an auxiliary connection section configured to be connectable with an auxiliary connection complimentary section provided on the battery mount portion of a specific kind of electric apparatus of the plurality of electric apparatuses, wherein:

the main connection section and the auxiliary connection section are configured such that the weight of the battery pack can be supported at the main connection section and the auxiliary connection section when the battery pack is connected to the battery mount portion of the specific kind of electric apparatus; and

the main connection section and the auxiliary connection section each comprise a pair of guide rails.

2. The battery pack according to claim 1, wherein: the main connection section and the auxiliary connection section are disposed at positions spaced apart from each other.

3. The battery pack according to claim 1, wherein: the auxiliary connection section is configured to be connectable with the auxiliary connection complimentary section as the auxiliary connection section is slid relative to the auxiliary connection complimentary section.

4. The battery pack according to claim 3, wherein: the main connection section is connectable with the main connection complimentary section of the battery mount portion of the specific kind of electric apparatus as the main connection section is slid relative to the main connection complimentary section in a first sliding direction; and

the auxiliary connection section is connectable with the auxiliary connection complimentary section of the battery mount portion of the specific kind of electric apparatus as the auxiliary connection section is slid relative to the auxiliary connection complimentary section in a second sliding direction; and

the first direction is the same as the second direction.

5. The battery pack according to claim 1, wherein the auxiliary connection complimentary section comprises a projection; and

the auxiliary connection section comprises an engaging portion configured to be engageable with the projection.

6. The battery pack according to claim 5, wherein: the engaging portion is disposed at a position determined such that the engaging portion engages the projection

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after the main connection section is slid in a direction relative to the main connection complimentary section of the battery mount portion of the specific kind of electric apparatus.

7. The battery pack according to claim 1, wherein: the main connection section and the auxiliary connection section are respectively connectable with the main connection complimentary section and the auxiliary connection complimentary section of the battery mount portion of the specific kind of electric apparatus; and the main connection section is connectable with the main connection complimentary section of the battery mount portion of a non-specific kind of electric apparatus of the plurality of electric apparatuses.

8. The battery pack according to claim 1, wherein: the guide rails each comprise a rail body and a lateral linear projection protruding outward in a widthwise direction of the rail body.

9. The battery pack according to claim 1, wherein: the main connection section is formed on a rear portion of the battery pack and the auxiliary connection section is formed on a front portion of the battery pack with respect to a forward and rearward direction of the battery pack, wherein the main and auxiliary connection sections extend in the same forward and rearward direction of the battery pack.

10. The battery pack according to claim 1, wherein: the auxiliary connection section is positioned outward with respect to a widthwise direction of the main connection section.

11. The battery pack according to claim 1, wherein: a length of the main connection section is longer than a length of the auxiliary connection section.

12. A system comprising:

a plurality of electric apparatuses each having a battery mount portion; and

a plurality of battery packs configured to be connectable with the battery mount portions of the plurality of electric apparatuses; wherein:

the plurality of electric apparatuses include a specific kind of electric apparatus and a non-specific kind of electric apparatus;

the plurality of battery packs include a specific kind of battery pack having a main connection section and an auxiliary connection section, and a non-specific kind of battery pack having a main connection section and no auxiliary connection section;

the battery mount portion of the specific kind of electric apparatus includes a main connection complimentary section and an auxiliary connection complimentary section, the main connection complimentary section being configured to be connectable with the plurality of battery packs as the plurality of battery packs are slid in a sliding direction relative to the main connection complimentary section, and the auxiliary connection complimentary section being connectable with the auxiliary connection section of the specific kind of battery pack;

the battery mount portion of the non-specific kind of electric apparatus includes a main connection complimentary section and no auxiliary connection complimentary section, the main connection complimentary section being configured to be connectable with the plurality of battery packs as the plurality of battery packs are slid in a sliding direction relative to the main connection complimentary section; and

the main connection section and the auxiliary connection section of the specific kind of battery pack are config-



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ured such that the weight of the specific kind of battery pack can be supported at the main connection section and the auxiliary connection section when the specific kind of battery pack is connected to the battery mount portion of the specific kind of electric apparatus.

## 13. A system comprising:

a specific kind of electric apparatus having a battery mount portion; and

a plurality of battery packs configured to be connectable with the battery mount portion; wherein:

the plurality of battery packs include a specific kind of battery pack having a main connection section and an auxiliary connection section, and a non-specific kind of battery pack having a main connection section and no auxiliary connection section;

the battery mount portion of the specific kind of electric apparatus includes a main connection complimentary section and an auxiliary connection complimentary section, the main connection complimentary section being configured to be connectable with the plurality of battery

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packs as the plurality of battery packs are slid in a sliding direction relative to the main connection complimentary section, and the auxiliary connection complimentary section being connectable with the auxiliary connection section of the specific kind of battery pack;

the main connection section and the auxiliary connection section of the specific kind of battery pack are configured such that the weight of the specific kind of battery pack can be supported at the main connection section and the auxiliary connection section when the specific kind of battery pack is connected to the battery mount portion of the specific kind of electric apparatus; and

the main connection section of the non-specific kind of battery pack is configured such that the weight of the non-specific kind of battery pack can be supported only at the main connection section when the non-specific kind of battery pack is connected to the battery mount portion of the specific kind of electric apparatus.

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